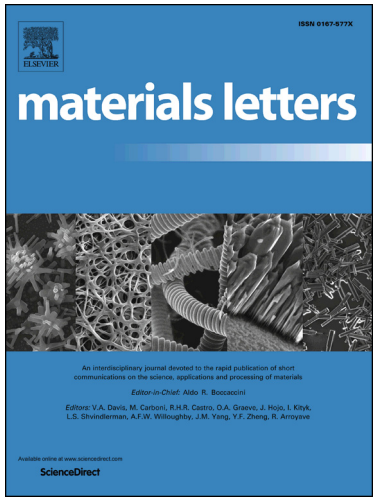
Accepted Manuscript



Porous piezoelectric ceramics with 3-3-connectivity fabricated by impregnation of cellulose paper structures

Franziska Eichhorn, Alexander Stenzel, Bastian Weisenseel, Nahum Travitzky, Ken-ichi Kakimoto, Peter Greil, Tobias Fey

PII: S0167-577X(17)31044-3
DOI: http://dx.doi.org/10.1016/j.matlet.2017.07.007
Reference: MLBLUE 22849

To appear in: *Materials Letters*

Received Date: 9 January 2017
Revised Date: 21 June 2017
Accepted Date: 2 July 2017

Please cite this article as: F. Eichhorn, A. Stenzel, B. Weisenseel, N. Travitzky, K-i. Kakimoto, P. Greil, T. Fey, Porous piezoelectric ceramics with 3-3-connectivity fabricated by impregnation of cellulose paper structures, *Materials Letters* (2017), doi: http://dx.doi.org/10.1016/j.matlet.2017.07.007

Porous piezoelectric ceramics with 3-3-connectivity fabricated by impregnation of cellulose paper structures

Franziska Eichhorn[1], Alexander Stenzel[1], Bastian Weisenseel[1,2], Nahum Travitzky[1], Ken-ichi Kakimoto[3,4], Peter Greil[1,2], Tobias Fey[1,4]*

[1] Department of Materials Science (Glass and Ceramics), University of Erlangen-Nürnberg, Martensstrasse 5, D-91058 Erlangen, Germany

[2]Energy Campus Nürnberg, Fürther Str. 250, 90429 Nürnberg, Germany

[3] Nagoya Institute of Technology, Department of Materials Science and Engineering, Institute of Ceramics Research and Education, Gokiso-cho, Showa-ku, Nagoya-shi, Aichi, 466-8555 Japan

[4] Frontier Research Institute for Materials Science, Nagoya Institute of Technology, Gokiso-cho, Showa-ku, Nagoya 466-8555, Japan

Abstract

Porous piezoelectric ceramics with an interconnecting pore network (3-3 piezoceramic-air-composites) are a compromising material for sensor applications. Using a biomorphous approach with pre-pyrolysed cellulose fiber paper as template for the impregnation process leads to a novel porous piezoelectric ceramic with a fiber microstructure and benefits on easy shaping of complex structures and high porosity (~ 90 vol. %). The templates were impregnated by a non-aqueous lead zirconate titanate (PZT) slurry (solid fracture of 52.3 %). After residual slurry and binder removal and cellulose/carbon burn-out, sintering was carried out at 1150 °C. Microstructure and composition analyses were done by µCT ("Skyscan 1172", Bruker), SEM (FESEM, Helios NanoLab 600i FIB Workstation, FEI) and X-ray diffraction measurements (Kristalloflex D500, Siemens AG) evaluation. Geometric density decreased by 30% compared to dense PZT (as reference) a porosity increased from 2.4% up to 86%. The piezoelectric properties as d_{33}, relative permittivity and d_{31} (measured by "Piezo-Meter PM 300", Piezo Test) decreased up to 99%.